Common Elements in ICP

Element	Symbol	Found in
Iron	Fe	Gears, roller bearings, cylinder/liners, shafts
Chromium	Cr	Roller bearings, piston rings
Nickel	Ni	Roller bearings, camshafts and followers, thrust washers, valvestems, valve guides
Molybdenum	Mo	Piston rings, additive, solid additive (Mo-di)
Aluminium	Al	Pistons, journal bearings, dirt
Copper	Cu	Brass/bronze bushes, gears, thrust washers, oil cooler cores, internal coolant leaks
Tin	Sn	Bronze bushes, washers and gears
Lead	Pb	Journal bearings, grease, petrol contamination
Silver	Ag	Silver solder, journal bearings (seldom)
Silicon	Si	Dirt, grease, additive
Sodium	Na	Internal coolant leaks, additive, sea water contamination
Lithium	Li	Grease
Magnesium	Mg	Additive, sea water contamination
Zinc	Zn	Additive (antiwear)
Phosphorus	P	Additive (antiwear, extreme pressure)
Boron	B	Additive, internal coolant leak, brake fluid contamination
Sulphur	S	Lubricant base stock, additive

Common wear situation as indicated by the ICP

Situation	Results
Dirt Entry	Si and Al present, usually in the ratio range of Si:Al between 2:1 and 10:1. Watch the increase in the trend. Often accompanied by associated wear when present over acceptable limits
Piston Torching	Al and Si in ratio Al:Si = 2:1. The Si originates from silicon carbide in the piston crown used to reduce the co-efficient of expansion. Seldom seen, as failure is usually rapid, and statistically there is little chance of getting a sample whilst occurring.
High Fe (alone)	As iron is the most used construction material, sources are often varied. Consider valve gear and oil pump wear. Rust formation also produces high Fe.
High Si (alone)	Silicon by itself comes from a few main sources - antifoaming agent additive, grease and silicone sealant. Usually seen in new/recently overhauled components. Usually can be ignored.
Top-end Wear	Characterised by increased Fe (cylinder liner), Al (pistons) and Cr (rings) levels. The presence of Ni usually indicates camshaft/cam follower wear.
Bottom-end Wear	Characterised by increased Fe (crankshaft) and Pb, Cu, Sn (white metal bearings and bronze bushes) levels. Often this wear is precipitated by reduced TBN or overcooling as bearings become subject to corrosion from combustion by-products (acids).
Overheating (some cases)	Increased additive levels (Mg, Ca, Zn, P & S) and viscosity. When light ends in the oil vaporise off, the oil level decreases. Topping up increases the additive concentrations, as the additives themselves do not evaporate. Oxidation often not evident, as topping up replenishes anti-oxidants and boosts the TBN. Often accompanied by Pb, Sn and Cu as bearing wear can result from this situation.
Bronze Bush Wear	Increased Cu and Sn levels. Cu:Sn ratio usually approximately 20:1.
Bronze gear/thrust washer wear	Increased Cu and Sn levels. Cu:Sn ratio usually approximately 20:1.
Internal coolant leaks	Increased Na, B, Cu, Si, Al and Fe. Not all elements may be present. Often accompanied by increased Pb, Cu and Sn as white-metal bearing wear often accompanies this. Water usually not evident, as it tends to boil off at normal operating temperatures.
Roller-bearing wear	Increased levels of Fe, Cr and Ni levels, all components of race and roller materials. Increased Cu might result if brass/bronze cages are employed.